

## REMARKS

The present application had claims 1 and 3-21 pending. Claims 10-16 have been withdrawn from consideration in the present application, but not yet canceled. Applicants have herein amended claims 1, 3-8, 17 and 21; have canceled claims 9, 18, 19 and 20; and have added new claims 22-25. Claims 1, 3-8, 17 and 21-25 are now under examination in the present application.

The claims which were previously directed to “catalyst-containing gas diffusion layers” have been amended to be directed to “membrane-electrode units” for a low-temperature fuel cells. Additionally, the gas diffusion layer of the invention has been restricted to an anode gas diffusion layer wherein the catalyst particles are gas-phase active. Support for amending the claimed subject matter to “membrane-electrode units” may be found throughout the application, including previously-pending claim 19 and on page 7, lines 14-15, and page 8, lines 32-33 and in the figure 2. Support for the additional limitations to the claims regarding “anode gas diffusion layer” and “gas-phase active” may be found on page 1, line 11, and figure 2 of the application and in the abstract for the term “anode” and in previously-pending claims 7 and 8 for the “gas-phase active” limitation. Support for amended claim 21 and added claims 22-24 may be found on page 7, lines 6 to 11, and in figure 1. Support for added claim 25 may be found on page 8, line 7, and in figure 2. None of the amendments introduces new matter to the present disclosure.

In the January 21, 2011 Office Action, the Examiner dismissed Applicants’ previous amendments alleging, *inter alia*, that they were “product by process” claim limitations and did not constitute structural differences distinguishing the claimed gas diffusion layer from the one allegedly taught by the combination of the cited prior art references. The Examiner thus maintained the rejection of the pending claims under 35 U.S.C. §103(a) as obvious over Hitomi, *et al.* (US Patent Publication 2002/0019308 A1) in view of Xie, *et al.* (US Patent 6,541,150).

Applicants respectfully disagree with the Examiner's position, but nevertheless have removed the limitations deemed to be "product by process" claim limitations, and have amended the claims to be directed to "membrane-electrode units" and have added additional limitations to independent claim 1 to further distinguish the claimed invention from the cited references. Specifically, claim 1 now requires that the claimed invention be a membrane-electrode unit comprising an ionomer membrane, an anode catalyst layer, a cathode catalyst layer, and an anode gas diffusion layer which contains catalyst particles in the layer that are "gas-phase active" and are distributed uniformly over the entire volume of the diffusion layer.

Neither the Hitomi reference nor the Xie reference discloses or suggest a membrane-electrode unit with the structure now set forth in the pending claims, as amended herein. The pending claims now require both an anode catalyst layer (which is in contact with the ionomer membrane and contains the electrochemically active catalyst) and an anode gas diffusion layer with gas-phase active catalyst particles uniformly distributed throughout the layer – thus, two types of catalysts in two different layers.

As asserted by the Examiner, Hitomi teaches an electrode which comprises a gas diffusion layer with catalyst particles on its surface, and Xie teaches a gas diffusion layer impregnated with a catalyst. It is clear from the teachings of both references that the catalysts involved are electrochemically active, and act as either the anode catalyst layer or the cathode catalyst layer. Neither reference is concerned with the removal of CO by means of gas-phase active catalyst particles – which are separate from the electrochemically active catalysts.

In Xie, the gas diffusion layer is impregnated with an electrocatalyst in order to permit the combining of the traditional catalyst layer and the gas diffusion layer into one layer (see Xie, col. 3, lines 14-16). This layer is then applied directly to a membrane – see figure 1.

In contrast, in the present invention, the gas diffusion layer has gas-phase active particles distributed throughout its volume so that it may act as a preanode for the

removal of CO. The gas diffusion layer of the present invention (with its gas-phase active catalyst particles) is then combined with a separate and distinct anode catalyst layer. Neither of the references, either alone or in combination, discloses the structure of the present invention.

At best, combining the Xie reference with the Hitomi reference results in the integration of an electrochemically active catalyst layer (either the anode or cathode catalyst layer) into one of the gas diffusion layers. The resulting structure would not have an anode gas diffusion layer (which contains catalyst particles that are gas-phase active and are distributed uniformly over the entire volume of the layer) AND a separate anode catalyst layer.

Additionally, the Hitomi and Xie references are both silent as to the added claim features concerning "anode gas diffusion layer" and "gas-phase active" catalyst particles. Both references disclose gas diffusion layers which are used for either sides of the fuel cell (see Hitomi, section 0087, and Xie, col. 6 line 65f), not an anode gas diffusion layer. The presently claimed invention now requires the presence of an anode gas diffusion layer having gas-phase active catalyst particles, which is used specifically on the anode side as a "preanode" for the removal of CO (see, for example, page 8, line 32, and page 10, line 7). This feature is not taught or suggested in either reference.

Further, the Xie and Hitomi references disclose gas diffusion layers wherein the catalyst particles are solely electrode catalysts – that is, the catalyst particles are electrochemically active, generating high electrical output in a fuel cell (see Xie, col. 5, lines 26-28, and Hitomi, para. 0008). Contrary to the disclosures and teachings of Hitomi and Xie, the presently claimed invention has catalyst particles that are gas phase active. The catalyst particles of the present invention remove CO from the fuel gas - for example by oxidation or methanization (see page 2, line 25, *et seq.*, and page 4, lines 13-16). The particles do not need to be electrically conductive or in contact with a proton conductive ionomer, like the particles of the cited references. There is no teaching or suggestion in either Hitomi or Xie regarding gas-phase active catalyst particles.

The presently claimed invention provides unexpectedly superior results – for example, improved CO tolerance (see Examples 1-3 and Table 1 of the present application).


In summary, the claimed invention as presently set forth in amended, independent claims 1 and 17 is patentably distinct from the membrane-electrode units of Hitomi and Xie. The remaining pending claims of the subject application depend from, and contain all the limitations of, independent claim 1. Accordingly, these claims are distinguishable from the Hitomi and Xie references based on the same reasons presented above for claim 1.

In light of the foregoing remarks and claim amendments, Applicants respectfully request withdrawal of the rejections set forth in the January 21, 2011 Office Action and solicit allowance of the present application.

No fee is believed due in connection with the filing of the present amendment, other than the fee for the requested two-month extension of time and the fee for the accompanying RCE, which Applicants are concurrently filing with the present response. If any additional fees are due, or an overpayment has been made, please charge, or credit, our Deposit Account No. 50-5371 for such sum.

If the Examiner has any questions regarding the present application, the Examiner is cordially invited to contact Applicants' attorney at the number provided below.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "John Santalone", written over a horizontal line.

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